secondaries. Our two male examples of this form are not quite fresh, and therefore the colouring below is not very defined, but it does not seem ever to have been rosy. It is possible, therefore, that a still drier type may remain to be discovered.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

The Life-Histories of the British Marine Food-Fishes. By William Carmichael M'Intosh, F.R.S., Professor, and Arthur Thomas Masterman, Assistant Professor of Natural History in the University of St. Andrews. 8vo. London, 1897. Pp. xvi, 516. Frontispiece, 20 coloured plates, and 45 woodcuts.

St. Andrews (now "The Gatty"*) Marine Laboratory has distinctly forged ahead in the issue of this volume, which is alike creditable for its clear graphic style and excellence of illustration. It is just such a handbook as those interested in practical ichthyology—and particularly the new band of students at work in marine laboratories—should have at hand for easy reference and instruction. It will save much groping for literature scattered through many scientific journals &c., home and foreign—a kind of ready reckoner in its way. In the preface the authors specify their respective shares in the labour, the major part of which comprises records of work accomplished at "The Gatty" itself—and a goodly show it makes of "north of Tweed" fish science (*perfervidum ingenium Scotorum*).

Stress is justly laid on Sars's discovery of floating eggs—truly the starting-point of much of the subsequent ichthyological research. They remark how difficult it is "to predicate from the habits of a fish the nature of its eggs."

Three propositions are laid down with respect to the pelagic eggs. Their pelagic character :—(1) "leads to the dispersion of the species throughout the ocean"; (2) "tends to minimize the destruction of the eggs by any special agency"; (3) "appears to have played an important part in the preservation of the various food-fishes." The first result is due to the effects of oceanic currents and tides; the second to the relative invisibility of the eggs; and the third to the lengthening of spawning discharge and very numerous diminutive eggs. Howsoever these may be active agents, it nevertheless seems to us to follow that the essential differences, together with the greater fecundity of the pelagic, as contradistinguished from the

* In courtesy to Dr. Charles H. Gatty, whose handsome gift of a new building has infused fresh life to the institution.

demersal, type, are but safeguards against the enormous disadvantages of the buoyant habit. Not that there is a superiority in pelagic spawning, as one would infer from the authors' remarks.

Masterman reasons * that pelagic spawning is the more primitive form. To such argument there can be no positive answer, inasmuch as all depends whether marine or freshwater forms were first evolved—and this in our present state of knowledge is pure guesswork. Quite a number of ichthyologists are of opinion—and solid proofs are not wanting—that many freshwater forms readily adapt themselves to a salt-water habitat, and equally so the opposite. Nay more, examples are numerous and marked where, in the same fish, seasonal or part of every-day life, so to say, is spent in both waters. If *Amphioxus* be taken as the lowest piscine form (older view), or only as the progenitor through the hagfish and lamprey to the vertebrate true fish (later view), then, from what we know of their spawning-habits and littoral sojourning, there may be as great a chance that ground-spawning is the primitive mode.

Reference is made to Dannevig's observation that the pelagic eggs of certain forms are chiefly shed at night. To this we may add that even in the parturition of higher vertebrates the same holds good. It is averred that the number of floating eggs bears a ratio to the breeding fishes, with which axiom most would agree. As to their ruthless destruction and the intense after-struggle for existence, it would be hard to deny. To this is necessarily related, wherefore in the pelagic forms do females preponderate, the contrary obtaining in demersal forms? It certainly is remarkable that, say, the sprat and herring, so closely allied, should one be pelagic, the other demersal in habit; so that the adult structure evidently has no influence as a determining factor. Nor does oil-globule in the egg or size of the latter characterize a particular group of fishes, the closest allies again differing.

In the short chapter "Fish from a Pelagic Egg" it is shown that in most cases prior to and immediately after hatching the kind of fish can be recognized by its pigmentation. Some are of canary tint, others ruby-red, or stone-coloured, or black and yellow, or alone black-banded, these hues being only youthful stages in coloration. Some, again, have great post-larval fins or spines and such-like ornamentation, which are modified or lost as age advances. Woodcuts dispersed in the text represent several of these changes as cod, ling, &c., so that the eye is there and then impressed on the reading of the text. But this part of the subject is so replete with interest and suggestion, that this chapter could well have been expanded with figures accordingly. The authors deftly call attention to similar stages in the development of the higher vertebrates as indicating genetic relations with ancestral forms.

The topic of pelagic fauna is one on which M'Intosh himself has

* Here introduced, but *cf.* Brit. Assoc. Rep. 1896, reprinted in Nat. Science, 1897.

made some instructive observations in St. Andrews Bay. He carefully noted the faunal monthly changes for a year, eliciting that, winter or summer, swarms of plant and animal surface organisms abounded. May was the maximum, January the minimum, and June, July, and August high in pelagic life. His researches, comprising surface, mid-water, and ground fauna prevalent in the bay at stated periods, to a limited extent only corroborate those of the praiseworthy 'Plankton' Atlantic Expedition. The method employed by him, less minute and systematic, but nevertheless fairly satisfactory for practical purposes, differed from that of Hensen, and gave no warrant to this savant's mathematical apportionment and supposed uniformity of the 'Plankton': the essence of the former's research, derived from superficial, mid, and ground netting, tending rather to prove that trawling of inshore waters cannot deprive food-fishes of nourishment by rendering the sea-bottom barren, as some authors have asserted. Withal it truly corresponded to Hæckel's expression of a "Wonderland" in his 'Plankton Studien,' and rather sustains Hæckel's views of the continuous variation of the surface organisms monthly, daily, and even hourly; hence he arrives at a conclusion opposed to that of Hensen, viz. that rigid accuracy is out of the question in such a biological problem. Garstang at Plymouth and Peck in the United States have each essayed on the same lines as M'Intosh, and there is every promise, when our bays, inlets, and estuaries are better worked out, that some at least of the inshore fish migrations will be more thoroughly understood, and theoretical as well as practical results follow.

In the "General Sketch of Marine Teleostean Development" what Balfour did for Elasmobranchs has been done in the Teleosts, and is here given in "a brief and somewhat popular *résumé*," quoting the authors' own words. The same is chiefly based on M'Intosh and Prince's monograph (Trans. Roy. Soc. Edinb. 1890). The present authors have, as a rule, eliminated controversial discussion or reference to the special labours of others' investigations, limiting their treatment of the subject as much as possible to the presumed facts of the case as tolerably well agreed on. In this way they have given a succinct but unusually clear scientific account of the processes involved from fertilization to ultimate hatching and issue of the embryo onwards, through larval and post-larval conditions to adolescence. Therefrom the student can easily follow the changes step by step, and finish with definite ideas of the cell-division, origin of membranes and organs, whether derived from epiblast, mesoblast, or hypoblast. The whiting and cod are the types taken, with woodcuts, to illustrate the gradation of changes in their embryology.

The authors tell us "very little is definitely known in connexion with the rate of growth of food-fishes." This statement rather takes us aback, for we were of opinion that, as Cunningham puts it, "a considerable amount of evidence has been collected bearing upon the question of the growth of fishes." Are the researches of Fulton,

Holt, Meyer, Petersen, Cunningham, Tosh, Dannevig, Williamson, and of Masterman and M'Intosh themselves mere moonshine? We should be very sorry to think so, though willing to allow that all the piscine laws of growth are not irrevocably settled. The authors admit and enunciate that "a study of the average sizes of fishes shows that the annual increase is practically distinctly appreciable"; that the artificially reared grow at a slower rate; that cold retards growth; that the larger species of fishes have a greater rate of growth from the outset; and, lastly, that growth continues throughout life—which makes their statement as above appear somewhat contradictory.

Section II. of the volume, which occupies its larger bulk, is entirely devoted to "Life-Histories of the Species" of Teleosteans. It embodies, in fact, in a very readable form all that is known with certainty of this group up to date. Altogether 86 species are recorded. The life-histories of some of these are described very fully, and to others shorter notice is bestowed, namely, where there is paucity of data. There is still, therefore, plenty of material left, awaiting aspiring young naturalists and those in favoured positions, to deal with. A great share of the work has been performed at St. Andrews, though the Plymouth station renders an admirable quota. The results of foreign savants' labours, many of whom have had opportunities of studying rarer fish and their ova under favourable circumstances not always accorded to our home-bred investigators, are freely used; but all authorities at home and abroad are frankly acknowledged. Still a condensed Bibliography (such as that of Bashford Dean in 'Fishes Living and Fossil') would have been a boon to students. The writers evidently rely on the extensive list of authors and works previously given in the memoir Trans. Roy. Soc. Edinb.; but, then, the student may not possess this.

To one of the writers it is a highly satisfactory budget to comment on in the fact that since the late Lord Dalhousie's Royal Commission of 1883, when almost next to nothing was known of the life-history of British food-fish, to-day there is a bright galaxy of forms pretty well known, and that St. Andrews helped to that measure with a will.

It is premised that though the Gobiidæ, Gasterosteidæ, and certain other families are not food-fish in the ordinary sense, yet they are included as evidence of what is known in Teleost life-histories. Occasionally such humble members throw a ray of light on obscure points in other fish of much more importance economically. The material and treatment of the subject is somewhat after the under-mentioned fashion, varied of course according to what is known of the species &c.:—Whether the fish is a pelagic or demersal spawner; the number of ova; comparative sizes and number of females to males; times and places of spawning; aspect, diameter, and other particulars concerning the egg; period of incubation and the daily progress &c. in development; the larva and

postlarva, their inherent stages and changes, their wanderings, and so on; the further growth of the young fish, their habits, migration, food, &c.; sexual maturity and conditions respecting the adults; differences in development, habits, &c. of families and species of a genus, and other significant facts connected with their life-histories; besides matter of a kind affecting the fisheries—altogether a vast store of information.

What is denoted as "Ontogenic migration," that movement towards and from the shallow shores and estuaries again to deep water, of the larval and postlarval forms, and which is shared by several families, Pleuronectidæ included, is rather ingeniously indicated graphically in diagrams in the case of the lesser sand-eel and the herring. These both have a spring and autumn spawning-period, which overlap each other, and the young and older stages get mixed shorewise, so that it has been puzzling to ascertain their age and rate of growth. To these diagrams the Italian phrase *se non è vero è ben trovato* appears applicable.

In discussing Delage's discovery of the transformation of that curious form *Leptocephalus Morrisii* into a young conger, and the further observations of Grassi and Calandruccio on *L. brevirostris* in relation to the eel, our authors seem to throw cold water on the question. They boldly ask:—(*a*) What is the normal habitat of the *Leptocephali*, at least *L. brevirostris* and *L. Morrisii*? (*b*) Why are they not found in abundance on our coasts? (*c*) Do abnormal *Leptocephali* occur, or, indeed, is a Leptocephaline stage a normal part of the Muræenoid life-history at all? It is worth while remarking that Günther ('Study of Fishes') regards *L. Morrisii* as an abnormal larval condition of the conger, and he suggests that shore-spawning fish-ova through untoward circumstances hatched in mid-ocean may not develop or attain their normal growth.

But we have said enough to justify our preliminary remarks, that the St. Andrews volume is both interesting and likely to prove useful.

In only one sentence is a solitary plaint heard, for otherwise throughout the tone is cheerful and encouraging. It runs thus:—"The authorities entrusted with the patronage of posts in which marine zoology could be studied as a rule and with a singular impartiality [*sic*] filled them with those accustomed to other departments of the subject, while men imbued with enthusiasm for marine zoology are stationed far inland." The old story of the angular man stuck in the round hole. By-the-bye, was not that high-souled, most eminently gifted naturalist Louis Agassiz spurned the Edinburgh chair, when the authorities should have felt proud of his application? We believe even Darwin would have been refused on the same grounds given by the objectors. *Sic transit gloria mundi*!